## 6A04

### Characteristics of Particulate Formation for Removal of $SO_2$ from Flue Gases by Corona Discharge Radical Shower Non-Thermal Plasma Systems†

R. Yamaguchi[1,2], M. Nimura[1,2], M. Itoh[1], J.S. Chang[2], K. Urashima[2], W.M. Wang[2,3], H.F. Hu[2,3], Y.X. Tong[3] and W.P. Liu[3]

*1. Dept. of Chemical Eng. and Materials Science, Doshisha University, Kyoto, Japan*
*2. Dept. Eng. Physics, McMaster University, Ontario, Canada*
*3. Safety and Environ. Protection Res. Inst., State Environmental Protection General Agency, Wuhan, P.R. China*

The corona discharge radical injection system for treatment of NOx and $SO_2$ has been investigated and demonstrated to improve significantly removal efficiency, energy efficiency, by-products yield etc. In the corona discharge radical injection technique, corona discharge is generated in front of a hollow electrode where ammonia, hydrocarbon, steam, oxygen, nitrogen, etc., were injected. Therefore, we can select radicals required for pollution gas treatments and minimize activations of unwanted flue gas components [1]. One of the mechanism of the corona radical shower system is that adiabatic expansion of $NH_3$ contained gas to form core aerosol particles from homogeneous condensation from nozzle exits. Aerosol surface reaction rates are a few orders of magnitude higher than that of the gas phase reaction rates. The other mechanism of NOx and $SO_2$ removal is formation of N (P), N (D), H, $N_2$*, NH and $NH_2$ radicals at the exit of nozzle electrode where strong electric field and high density plasma exist for promote oxidation and reduction reactions. In this work, the mechanism of NOx and $SO_2$ convertion to aerosol particles at downstream of reactors, reacting with slip $NH_3$, and core aerosol particles generated by homogeneous condensation and ion induced aerosol formations will be investigated in detail [2]. Experiments were conducted for the flue gas rate from 3 to 12 $Nm^3/h$, the $NH_3$ to acid gas molecule ratio from 0.5 to 1.5, applied voltage from 0 to 27 kV and $SO_2$ initial concentration from 500 to 1000 ppm. The results show that $SO_2$ removal efficiency increases with increasing ammonia radical injection rate and in-put electrical power. We observed slip $NH_3$ increases with increasing mole ratio and decreases with increasing applied voltage. However, $SO_2$ removal efficiency decreases with increasing mole ratio without discharge. Also, results show that the formation of aerosol particles as well as the particle size distribution depends on applied voltage and initial concentration of $SO_2$.

[1] J. Y. Park, I. Tomcic, G. F. Round and J. S. Chang; J. Phys. D. Appl. Phys., 32, 1006-1011, 1999 [2] K. Urashima, T. Ito and J. S. Chang; J. Aerosol Sci, 29, S621-622, 1998

† changj@mcmaster.ca

## 6A05

### Experimental Study for Control of VOCs using Plasma-Catalyst Hybrid System†

J.O. Chae*1, G.M. Vasiliev*2, V.I. Demidiouk*1, N.M. Yeulash*1 and I.C. Choi*1

**1 Dept. of Mech. Eng., INHA Univ.*
*253 Younghyun-dong, Nam-gu, Inchon, Korea*
**2 A.V.Luikov Heat and Mass Transfer Institute National Academy of Sciences of Belarus*
*15 P. Brovka Str., Minsk, 220072, Republic of Belarus*

In this study, a new plasma-catalyst continuously regenerative hybrid system is introduced to neutralization of odors and reductions of specific volatile organic compounds (VOCs) in the indoor air environment.

The searching of the several metal oxides catalysts for the decomposition of VOCs was introduced and investigated in the combination with a plasma reactor. The plasma reactor with using pulse power supply was used and several kinds of catalysts were studied. It was found that catalyst could solve the problem of by-product formation at the same time plasma significantly increases the efficiency of the catalytic removing about some kinds of VOCs pollutants. Moreover the effect of a combined treatment is higher than the sum of individual steps. This synergy effect is partly due to the catalytic oxidation with ozone and other active particles produced in the discharge. The catalyst moves the process towards total oxidation and the by-products formed during the plasma treatment are oxidized to $CO_2$.

† fire@inha.ac.kr